Quantitative High Definition XFM Element Imaging using Maia: the Challenge of Major Composition Contrasts

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Abstract

Extreme contrasts in sample composition cause dramatic variation in X-ray fluorescence microscopy (XFM) yields due to self-absorption. Without *a priori* knowledge of spatial composition details, the projection of element images from XFM data using the Dynamic Analysis (DA) method [1,2] in the GeoPIXE software assumes a uniform composition and background shape. Our present approach is to then apply an iterative matrix (composition) correction. But this does not account for changing background shape and scattering and X-ray relative intensities evolving spatially with composition.

The XFM beamline [3] of the Australian Synchrotron equipped with a Maia detector [4,5], uses DA to process event data in XFM imaging and tomography at up to ~3 x 10^7 events/s in the Maia FPGA processor for real-time imaging or ~10^8 on a performance desktop, corresponding to ~10^4-10^5 pixels/s and images up to ~100M pixels. The challenge is to improve the method while maintaining processing speed.

A new method, applied in a second pass, uses an end-member phase decomposition obtained from the first pass, and DA matrices determined for each end-member, to re-process the event data with each pixel treated as an admixture of end-member terms. This approach better tracks spatially complex samples as encountered in geological and environmental research (e.g. Fig. 1) while still benefitting from the speed of DA. This paper describes the method and illustrates how the enhanced accuracy of spectral deconvolution improves imaging of challenging materials. Direct spot comparisons with electron probe microanalysis are used to illustrate the accuracy of the method.

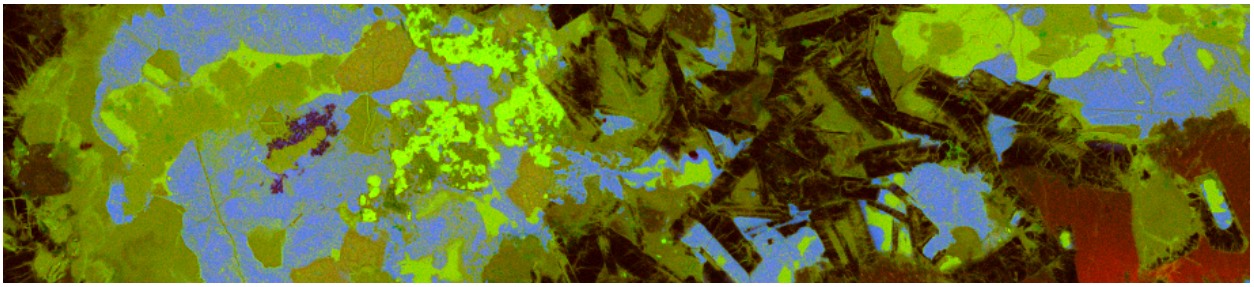

Figure 1: Maia RGB image (Cr Fe Cu, 7401 x 1650 pixels; portion of 7401 x 4601 pixels, 14.8 x 9.2 mm) of a complex geological sample acquired at the XFM beamline, illustrating challenging compositional variation.

References

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